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TI Heat-resistant copper-base alloys
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AB Claimed Cu alloys contain Co 0.10-1.0, Sn 0.10-1.0, P 0.02-0.20, and Zn 0.01-2.0 weight%. Also claimed are Cu alloys containing Co 0.05-0.7, Sn 0.10-1.0, P 0.02-0.20, Zn 0.01-2.0, and Ni 0.05-0.7, Fe 0.05-0.5, Mn 0.01-0.30, and/or Mg 0.005-0.10 weight%. The alloys are especially suitable for heat-exchanger tubes.

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[Claim(s)]

[Claim 1] The heat-resistant copper machine alloy characterized by making the metal presentation which 0.10 to 1.0 weight % of Cobalt, and 0.02 to 0.20 weight % of phosphorus and 0.01 to 2.0 weight % of zinc are contained, and the remainder becomes from copper and an inevitable impurity. [0.10 to 1.0 weight % of tin, and]

[Claim 2] 0.05 to 0.7 weight % of Cobalt, and 0.10 to 1.0 weight % of tin, 0.02 to 0.20 weight % of phosphorus, and 0.01 to 2.0 weight % of zinc and 0.05 to 0.7 weight % of nickel, The heat-resistant copper machine alloy characterized by making the metal presentation which a kind or two sorts of elements chosen from 0.05 to 0.5 weight % of iron, 0.01 to 0.30 weight % of manganese, and 0.005 to 0.10 weight % of magnesium are contained, and the remainder becomes from copper and an inevitable impurity.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This inventions are the product or parts for which a heat-resisting property is needed like the heat exchanger tube used for heat exchangers, such as an instantaneous hot water heater and a hot-water supply machine, in addition to thermal conductivity and conductivity. It is related with the heat-resistant copper machine alloy suitably used as a component of the product especially heated by solder attachment etc. by the high temperature more than considerable at the time of manufacture and use, or parts.

[0002]

[Description of the Prior Art] Generally although the copper machine alloy is used as a component of the product which needs thermal conductivity and conductivity, or parts Most generally as a component of the product which needs a heat-resisting property like the heat exchanger tube especially used for heat

exchangers, such as an instantaneous hot water heater and a hot-water supply machine, or parts, phosphorus deoxidized copper (JIS C1220) excellent in the heat-resisting property is used.

[0003] By the way, the heat exchanger tube used, for example for heat exchangers, such as an instantaneous hot water heater and a hot-water supply machine, is heated by the high temperature more than considerable, in order to attach a copper fin, a copper shell plate, etc. and to attach a fin etc. generally at the time of the manufacture.

[0004] That is, although a fin, a shell plate, etc. are attached in a heat exchanger tube by brazing solder attachment, welding, etc., a part (portion in which a fin etc. is attached) and the whole of a heat exchanger tube will be temporarily heated by high temperature with soldering heat, welding heat, etc. in that case. For example, generally, soldering of a heat exchanger tube, a fin, a shell plate, etc., etc. is in the state which set proper solder attachment material there while fixing a heat exchanger tube to the solder attachment part for a fin etc., and it is performed by passing the inside of the heating furnace (continuous heat treating furnace) held at the non-oxidizing atmosphere. [if it is in this ****** attachment method, generally, ****** (JIS Z3264 BCuP-2) is used in consideration of the field of hardness or cost as soldering material, but] Since the fusing points of this ****** are the solidus temperature of 710 degrees C, and the liquidus temperature of 795 degrees C, at the time of solder attachment, the whole heat exchanger tube will be heated at about 800 degrees C in a furnace. Moreover, although the ****** attachment method may not be employable depending on the form or structure of a heat exchanger tube containing a fin etc., solder attachment is performed by not using a heating furnace but heating artificially the required parts (solder attachment part) of a heat exchanger tube including soldering material, a fin, etc. in this case. Also in this case, solder attachment conditions, such as the quality of the material of solder attachment material and its cooking temperature, will be the same also in the ****** attachment method, and a heat exchanger tube will be locally heated by about 800 degrees C. Also when based on welding, high temperature heating of the part of a heat exchanger tube to be welded will be carried out like the case where it is based on the starting artificial solder attachment method, comparable as solder attachment temperature (about 800 degrees C), or more than it.

[0005]

[Problem to be solved by the invention] However, if it is in the heat exchanger tube made from phosphorus deoxidized copper, when it is heated by high temperature of about 800 degrees C or more locally or on the whole by solder attachment of the above-mentioned fin etc., and welding, in order that the grain of phosphorus deoxidized copper may become big and rough, In the matrix hardness in phosphorus deoxidized copper being low, the mechanical strength (for example, tensile strength, proof strength, elongation, fatigue strength, hardness, etc.) after heating (solder attachment rear stirrup after welding) will fall remarkably conjointly. About proof strength and especially fatigue strength, the fall is excessive. In addition, although it changes somewhat with material manufacture conditions, such as a heat exchanger tube, the fall of the mechanical strength by big-and-rough-izing of the grain in such a heat exchanger tube made from phosphorus deoxidized copper etc. is notably accepted, when generally heated by 600-700 degrees C or more.

[0006] Therefore, since the mechanical strength of a heat exchanger tube was falling in the manufacture stage if it is in heat exchangers which use the heat exchanger tube made from phosphorus deoxidized copper, such as an instantaneous hot water heater and a hot-water supply machine, naturally the problem was in endurance. For example, if it was in an instantaneous hot water heater, a hot-water supply machine,

etc., in order that a heat exchanger tube might repeat thermal expansion and thermal contraction frequently by the use, there was fear, like a heat exchanger tube carries out a fatigue breakdown locally according to the repetition load by it, and there was a problem that a life cycle was short.

[0007] High temperature heat treatment has been carried out [high temperature heating or] by such problem not only at the heat exchanger tube which needs hard solder attachment and welding but at the time of manufacture or use. Also when heated by temperature (generally 600-700 degrees C or more) which is just going to be pointed out in the product made from all phosphorus deoxidized copper, and parts, and the grain of phosphorus deoxidized copper makes big and rough, development of the heat-resistant copper machine alloy with which mechanical strength and thermal conductivity, or conductivity does not fall remarkably is demanded strongly.

[0008] This invention was made so that it may respond to this request, and it can be conveniently used as a component of the product which may be heated by high temperature which the grain of phosphorus deoxidized copper makes big and rough at the time of manufacture and use (or heat treatment), and parts. It aims at offering the heat-resistant copper machine alloy with which mechanical strength and thermal conductivity, or conductivity does not fall after this heating.

[0009]

[Means for solving problem] In this invention, the heat-resistant copper machine alloy which makes the following metal presentations is proposed that the above-mentioned purpose should be attained.

[0010] [namely, the copper machine alloy of invention (it is called the following "the 1st invention") indicated to Claim 1] The metal presentation which 0.10 to 1.0 weight % of Cobalt, and 0.02 to 0.20 weight % of phosphorus and 0.01 to 2.0 weight % of zinc are contained, and the remainder becomes from copper and an inevitable impurity is made. [0.10 to 1.0 weight % of tin, and]

[0011] [moreover, the copper machine alloy of invention (it is called the following "the 2nd invention") indicated to Claim 2] 0.05 to 0.7 weight % of Cobalt, and 0.10 to 1.0 weight % of tin, 0.02 to 0.20 weight % of phosphorus, and 0.01 to 2.0 weight % of zinc and 0.05 to 0.7 weight % of nickel, The metal presentation which a kind or two sorts of elements chosen from 0.05 to 0.5 weight % of iron, 0.01 to 0.30 weight % of manganese, and 0.005 to 0.10 weight % of magnesium are contained, and the remainder becomes from copper and an inevitable impurity is made.

[0012] Cobalt is an essential element for controlling big and rough-ization of the grain under the high temperature heating conditions at the time of manufacture of a heat exchanger tube etc., or use (for example, under about 800-degree C heating condition at the time of hard solder attachment). That is, by addition of Cobalt, the grain growth when being heated by high temperature (600-700 degrees C or more) can be controlled good, and a metal presentation can be made to hold minutely, and the fatigue resistance of the alloy after high temperature heating improves. It **, and the effect by such Cobalt addition is not fully demonstrated, when the amount of addition is less than 0.10 weight %. However, so that it may mention later in making a kind or two sorts of elements [as / in the 2nd invention] (henceforth [when naming generically and saying these] "**** nickel" etc.) chosen from nickel, iron, manganese, and magnesium add With an operation of **** nickel etc., conjointly, if it is 0.05 weight % or more even if the amount of Cobalt addition is less than 0.10 weight %, the above-mentioned effect will fully be demonstrated. On the other hand, there is a limit in the effect by the Cobalt addition, the addition more than needed is meaningless, the effect of balancing the amount of addition cannot be acquired, and there is a possibility of spoiling the

characteristics of copper machine alloy original, such as conductivity and thermal conductivity, on the contrary. that is, even if it adds Cobalt exceeding 1.0 weight % (it is 0.7 weight % when making **** nickel etc. add), the conductivity and thermal conductivity which are that only the effect of balancing it is not acquired, and the characteristics of on the contrary copper machine alloy original fall -- things -- ** Of course, since Cobalt is very expensive, also economically, adding this more than needed has a problem. Since it was such, the amount of addition of Cobalt was made into 0.10 to 1.0 weight % when **** nickel etc. was not added, and when **** nickel etc. made it add, it could be 0.05 to 0.7 weight %.

[0013] Although phosphorus exhibits the grain growth inhibition function by high temperature heating like Cobalt, the function improves by leaps and bounds by **** with Cobalt. Therefore, by adding phosphorus in addition to Cobalt, the grain growth by high temperature heating is controlled very effectively, and a crystallized state even with after [detailed] heating is maintained certainly. It **, and at less than 0.020 weight %, the amount of addition is not demonstrated effectively and cannot expect the effect by addition of this phosphorus so much. However, conductivity and thermal conductivity will fall [that the effect of balancing the amount of addition is not acquired even if it adds exceeding 0.20 weight %, and] on the contrary, and, moreover, hot working nature will also fall. Therefore, the amount of addition of phosphorus was made into 0.02 to 0.20 weight %.

[0014] Tin may increase the deposition rate of Cobalt and phosphorus while raising the grain growth depressant action by above-mentioned Cobalt and phosphorus, and a miniaturized operation by solid solution strengthening to a matrix, and it raises the mechanical strength after high temperature heating. However, if the amount of addition is not fully demonstrated at less than 0.10 weight % and the effect by addition of this tin exceeds 1.0 weight %, although mechanical strength will improve to some extent according to the amount of addition, conductivity and thermal conductivity will fall. The amount of addition of tin was made into 0.10 to 1.0 weight % from this Reason.

[0015] Zinc is added in order to aim at improvement in mechanical strength by strengthening of a matrix. That is, since the mechanical strength as the whole alloy will naturally become low when the hardness of the matrix itself is low however detailed a grain may be, zinc is added in order to strengthen this matrix. Although tin of this point is also the same, zincky addition does so further the effect of raising solder attachment nature. that is, a wettability with solder attachment material, such as ****** (JIS Z3264), can be raised by adding zinc -- it is. It **, and if the amount of addition is not fully demonstrated at less than 0.01 weight % but exceeds 2.0 weight % conversely, while conductivity and thermal conductivity will fall, as for the effect of this zincing, the susceptibility over a stress crack or corrosion cracking becomes high. The zincky amount of addition was made into 0.01 to 2.0 weight % from this Reason.

[0016] Nickel, iron, manganese, and magnesium are added in order to reduce the amount of addition of expensive Cobalt as much as possible, maintaining the above-mentioned effect by the Cobalt addition. That is, nickel or iron makes the degree of Cobalt solid-solution limit to a matrix decrease, plays the role which demonstrates the Cobalt function effectively in the small amount of addition, and demonstrates an economical effect. Furthermore, while Cobalt, nickel, and the synergistic effect by **** with phosphorus raise conductivity and thermal conductivity more, further heat-resistant improvement is aimed at according to Cobalt, iron, and the synergistic effect by **** with phosphorus. Moreover, the degree of Cobalt solid-solution limit to a matrix is made to decrease like [manganese or magnesium] nickel and iron. The role which demonstrates the above-mentioned Cobalt function effectively in the small amount of addition is played, and

there is an effect which raises the conductivity of heat and electricity and raises hot working nature by decreasing the amount of dissolution of Cobalt. It ** and is done so by the effect by addition of this **** nickel etc. choosing one sort or two sorts in nickel, iron, manganese, and magnesium, and adding, and even if three or more sorts add, the addition effect of balancing it is not accepted. And the amount of addition [less than 0.05 weight % of nickel, less than 0.05 weight % of iron, less than 0.01 weight % of manganese, and less than 0.005 weight % of magnesium] The above-mentioned addition effect is not fully demonstrated, but the addition effect of balancing the amount of addition depending on addition conversely exceeding 0.7 weight % of nickel, 0.5 weight % of iron, 0.30 weight % of manganese, and 0.10 weight % of magnesium is not accepted, and the evil of conductivity and thermal conductivity falling on the contrary is produced. About the range of this amount of addition, not only when making one sort in nickel, iron, manganese, and magnesium add, but when making two sorts add, it is the same. Since it was such, the amounts of addition, such as **** nickel, were used as 0.05 to 0.7 weight % of nickel, 0.05 to 0.5 weight % of iron, 0.01 to 0.30 weight % of manganese, and 0.005 to 0.10 weight % of magnesium.

[0017] [after the copper machine alloy of the 1st invention which ** and makes such a metal presentation, or the 2nd invention was heated by high temperature of 600-700 degrees C or more by hard solder attachment, heat treatment, etc.] Mechanical strength does not fall, but he has good thermal conductivity, conductivity, solder attachment nature, etc., and it will be understood easily and clearly from the work example described below that it is what can be conveniently used as components, such as a heat exchanger tube of a heat exchanger.

[0018]

[Working example] That is, respectively, the high frequency fusion furnace was used, the air dissolution of copper machine alloy (it is called the following "work-example alloy") No.1 concerning this invention which makes the alloy composition shown in Table 1 - No.14 was carried out under covering of charcoal, and the ingot 35mm in thickness, 90mm in width, and 250mm in length was obtained. And each ingot was heated at 850 degrees C, and the 5-mm-thick tabular material was obtained by hot-rolling. The 0.6-mm-thick plate was obtained by performing finish rolling between the colds, after carrying out pickling treatment of the surface, cold-rolling each tabular material so that it might be set to 0.63mm in thickness and annealing it further after an appropriate time. In addition, work-example alloy No.1 - No.4 are the copper machine alloys concerning the 1st invention, and work-example alloy No.5 - No.14 are the copper machine alloys concerning the 2nd invention.

[0019]

[Table 1]

銅基合金No.		合金組成（重量%）								
		Co	Sn	P	Zn	Ni	Fe	Mn	Mg	Cu
実施例	1	0.19	0.81	0.05	1.41	–	–	–	–	残部
	2	0.71	0.15	0.16	0.03	–	–	–	–	残部
	3	0.25	0.32	0.06	0.77	–	–	–	–	残部
	4	0.46	0.23	0.09	0.35	–	–	–	–	残部
	5	0.21	0.32	0.07	0.77	0.23	–	–	–	残部
	6	0.19	0.33	0.07	0.75	0.19	0.09	–	–	残部
	7	0.18	0.40	0.06	0.27	0.19	–	0.07	–	残部
	8	0.31	0.19	0.11	0.18	0.15	–	–	0.02	残部
	9	0.13	0.33	0.08	0.65	–	0.27	–	–	残部
	10	0.25	0.31	0.07	0.67	–	0.10	0.04	–	残部
	11	0.12	0.34	0.07	0.61	–	0.32	–	0.06	残部
	12	0.22	0.38	0.06	0.48	–	–	0.13	–	残部
	13	0.49	0.22	0.09	0.29	–	–	0.05	0.01	残部
	14	0.34	0.52	0.08	1.12	–	–	–	0.03	残部

[0020] Moreover, copper machine alloy (it is called the following "comparative example alloy") No.21 which makes the alloy composition shown in Table 2 as a comparative example - No.26 were respectively dissolved under the same conditions as the above-mentioned work example, and the ingot of the same form was obtained. And the plate (0.6mm in thickness)-shaped [same] was obtained from each ingot according to the same process under the same conditions as the above-mentioned work example. However, about comparative example alloy No.26, since the crack arose in the stage which hot-rolled the ingot, a plate was not able to be obtained. In addition, comparative example alloy No.21 are phosphorus deoxidized copper (JIS C1220) currently generally used as components, such as a heat exchanger tube of a heat exchanger, as the beginning described.

[0021]

[Table 2]

銅基合金No.		合金組成（重量%）								
		Co	Sn	P	Zn	Ni	Fe	Mn	Mg	Cu
比較例	21	–	–	0.03	–	–	–	–	–	残部
	22	0.27	0.02	0.07	0.68	–	–	–	–	残部
	23	0.37	0.38	0.01	0.75	–	–	–	–	残部
	24	0.03	0.41	0.08	0.68	0.38	–	–	–	残部
	25	0.38	1.35	0.08	0.73	–	–	–	–	残部
	26	0.38	0.42	0.28	0.85	–	–	–	–	残部

[0022] It heat-treated at 800 degrees C (10 minutes) by passing the inside of a continuous heat treating furnace on the same conditions as the case where the ****** attachment method is enforced for each plate obtained in this way. The temperature change of each plate at this time is as being shown in drawing 1 .
[0023] And about each plate heat-treated in this way, respectively, while measuring a grain size number and electric conductivity, the tension test and fatigue test (Schenck type repetition **** fatigue test) by a conventional method were done using the specimen obtained from each plate. namely, -- in a tension test -- tensile strength (N/mm2) -- and -- it being extended, measuring (%) and setting to a fatigue test -- 105 the fatigue strength (N/mm2) and fatigue strength to the number of repetitions -- 100Ns/mm2 The number of repetitions when reaching (fatigue life) was measured.
[0024] The result was as being shown in Table 3. In addition, about the thing concerning comparative example alloy No.26, since a plate was not able to be obtained as mentioned above, these measurement and an examination are omitted.
[0025]
[Table 3]

銅基合金	No.	結晶粒度 mm	導電率 %IACS	引張試験		疲れ試験	
				引張強さ N/mm²	伸び %	疲れ強さ N/mm²	繰り返し数 $\times 10^5$
実施例	1	0.015	61	278	43	158	13
	2	0.005	66	291	40	172	25
	3	0.010	73	267	44	144	8
	4	0.005	65	275	41	151	10
	5	0.010	72	273	43	143	10
	6	0.010	64	277	42	149	11
	7	0.010	62	268	42	145	9
	8	0.010	63	273	43	147	10
	9	0.005	61	269	40	153	12
	10	0.010	65	272	43	148	10
	11	0.005	60	271	40	149	11
	12	0.015	70	266	45	142	8
	13	0.005	67	274	40	150	11
	14	0.010	62	271	42	150	11
比較例	21	0.3	87	207	26	84	0.7
	22	0.015	57	253	43	119	2
	23	0.10	49	248	40	113	1.3
	24	0.12	55	239	39	114	1.2
	25	0.005	42	285	40	167	17
	26	–	–	–	–	–	–

[0026] Moreover, about the plate which consists of comparative example alloy No.21, measurement, the above-mentioned tension test, and above-mentioned fatigue test of a grain size number and electric conductivity were done also in the stage before putting into a continuous heat treating furnace (before

heating at 800 degrees C). the result -- grain size number:0.020mm, electric conductivity:87%IACS, and tensile strength: -- 259Ns/mm2 are extended -- :40%, fatigue strength:140N/mm2, and number of repetitions (fatigue life):5x105 it was .

[0027] By the way, it is in heat, a copper machine alloy, an aluminium which are rich in electric conductivity, etc., and heat conductivity and electric conductivity show very high correlation. That is, if they are in approximately regulated proportionality relation, for example, heat conductivity is in a high copper machine alloy, electric conductivity is also high, and heat conductivity is also high [both] if both have electric conductivity in a high copper machine alloy conversely. therefore, [aluminium / a copper machine alloy or] Since heat conductivity or a thermally conductive quality had been grasped to considerable grade accuracy by measuring the electric conductivity, we decided to perform the relative evaluation of a work-example alloy and comparative example alloy mutual heat conductivity (thermal conductivity) with the measured value of electric conductivity here.

[0028] It **, and from these results, by comparative example alloy No.21 which are phosphorus deoxidized copper, as the beginning described, when heated by 800 degrees C which is solder attachment temperature, it is understood that a grain becomes big and rough and mechanical strength falls sharply. That is, although a grain size number is 0.020mm before heating, after heating is 0.3mm and the grain has made it big and rough sharply. And [although the heat conductivity grasped before and after heating electric conductivity and after this did not change, about mechanical strength, were 140Ns / mm2 (fatigue strength) / /and 5x105 259Ns / mm2 (tensile strength) / /and 40% (elongation) before heating (the number of repetitions), but] It is set to 84Ns [mm2 (fatigue strength)] /and 0.7x105 (the number of repetitions) 2 (tensile strength) or 26% of 207Ns/mm (elongation) after heating, and is falling sharply by having heated at 800 degrees C.

[0029] On the other hand, about work-example alloy No.1-No.4 and No.5-No.14, after being heated by 800 degrees C, the grain size number is smaller than comparative example alloy No.21 before heating (phosphorus deoxidized copper), and it is understood that a grain hardly becomes big and rough. If hardly falling is naturally understood and the mechanical strength after heating compares with comparative example alloy No.21 after heating from this even after mechanical strength's heating, even if it compares with the comparative example alloy 21 before heating, of course, it is clearly understood from Table 3 that it is high sharply. Namely, so that clearly from Table 3 [work-example alloy No.1 - No.14] [about the all, it is equivalent to comparative example alloy No.21 before the elongation after heating heating in work-example alloy No.2, No.9, No.11, and No.13, and also] both the tensile strength after heating elongation fatigue strength and the number of repetitions (fatigue life) -- although -- it has far exceeded comparative example alloy No.21 before heating. Therefore, if the heat-resistant copper machine alloy concerning this invention is used as a component Can improve sharply the endurance of a product and parts, a constant failure rate period, etc. which make a component phosphorus deoxidized copper (comparative example alloy No.21) which is the most common heat-resistant copper machine alloy in the former for them, and further Utilization of the product which could not use phosphorus deoxidized copper etc. in respect of the mechanical strength after high temperature heating etc., and parts is enabled, and the use of a copper machine alloy can be expanded sharply.

[0030] [moreover, the heat conductivity grasped the electric conductivity of work-example alloy No.1 - No.14, and from now on] Although it is lower than comparative example alloy No.21 as shown in Table 3,

comparable as the electric conductivity and heat conductivity which are generally needed for the product made from phosphorus deoxidized copper and parts (for example, heat exchanger tube of a heat exchanger etc.), or the value beyond it is shown, and there is no problem in particular. For example, as components, such as a heat exchanger tube of a heat exchanger, the aluminium besides phosphorus deoxidized copper is used from the former, and the electric conductivity of this aluminium is about 60%IACS, and the low thing of the electric conductivity of work-example alloy No.1 - No.14 is also equivalent to the electric conductivity of an aluminium. Therefore, if it is in the product and parts (heat exchanger tube of a heat exchanger etc.) which are used as a component about an aluminium at least, when using the copper machine alloy which replaces with an aluminium and is applied to this invention, thermal conductivity or conductivity does not pose a problem.

[0031] On the other hand, as for comparative example alloy No.22 - No.24, the electric conductivity (heat conductivity), the fatigue strength, and the fatigue life (the number of repetitions) after heating at 800 degrees C are low clearly rather than work-example alloy No.1 - No.14. Moreover, although comparative example alloy No.25 are equivalent as compared with work-example alloy No.1 - No.14 as for fatigue strength and a fatigue life (the number of repetitions), the electric conductivity (heat conductivity) after heating at 800 degrees C is low clearly. The meaning determined from these things as the amount of addition of each element and selection of the alloying element were mentioned above in this invention was checked clearly. In addition, about comparative example alloy No.26, as mentioned above, a problem is in hot working nature, and things which component ****** is as for nothing, such as a heat exchanger tube, are clear.

[0032] By the way, although hard solder attachment was carried out as soldering material about work-example alloy No.1-No.14 using ****** (JIS Z3264), any problem was not produced to the solder attachment nature, either, but it was checked that the copper machine alloy concerning this invention is excellent also in solder attachment nature.

[0033]

[Effect of the Invention] So that I may be easily understood also from the above explanation [the heat-resistant copper machine alloy of this invention] Also when heated by the high temperature (600-700 degrees C or more) that the grain of phosphorus deoxidized copper which is the most common heat-resistant copper machine alloy is made big and rough, a grain is not made big and rough by heating, and the characteristics (thermal conductivity, conductivity, etc.) of mechanical strength or copper alloy original do not fall. [after / heating] Especially about mechanical strength, it is improving sharply as compared with phosphorus deoxidized copper, and the mechanical strength after heating is superior to phosphorus deoxidized copper before heating.

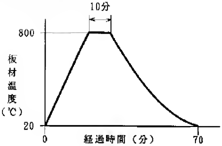
[0034] Therefore, according to the heat-resistant copper machine alloy of this invention, it is exposed to high temperature of 600-700 degrees C or more at the time of manufacture or use (especially). The endurance about various products, such as a heat exchanger tube of the heat exchanger heated by 800 degrees C or more by hard solder attachment or welding, and parts or a constant failure rate period can be sharply raised as compared with the general thing made from phosphorus deoxidized copper.

[0035] And as compared with the case where phosphorus deoxidized copper is used, a large expansion of the use is expected by using the heat-resistant copper machine alloy of this invention as a component.

[Brief Description of the Drawings]

[Drawing 1] It is the graph in which the relation of the temperature change of the plate concerned and lapsed time at the time of passing the inside of a continuous heat treating furnace on the same conditions as the case where the ****** attachment method is enforced for each plate which consists of a work-example alloy or a comparative example alloy is shown.

[Drawing 1]



[Translation done.]